

intended use for the claimed ink, and therefore has not considered it in assessing the patentability of the claimed ink. However, for the reasons indicated below, Applicant takes the position that the expression “for ink jet printer” must be considered in determining the issue of patentability of the present invention over the prior art.

Thus, referring to MPEP 2111.02, if the claim preamble, when read in the context of the entire claim, recites limitations of the claim, or, if the claim preamble is necessary to give life, meaning, and vitality to the claim, then the claim preamble should be construed as if in the balance of the claim. *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165-1166 (Fed. Cir. 1999).

This section of the Manual also cites *Kropa v Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951), involving a preamble reciting “An abrasive article” which was deemed essential to point out the invention defined by claims to an article comprising abrasive grains and a hardened binder and the process of making it. The court stated “it is only by that phrase that it can be known that the subject matter defined by the claims is comprised as an abrasive article. Every union of substances capable *inter alia* of use as abrasive grains and a binder is not an ‘abrasive article.’” Therefore, the preamble served to further define the structure of the articles produced.

MPEP 2111.02 also quotes from *In re Stencel*, 828 F.2d 751, 4 USPQ2d 1071 (Fed. Cir. 1987), wherein the claim at issue was directed to a driver for setting a joint of a threaded collar, however the body of the claim did not directly include the structure of the collar as part of the claimed article. The examiner did not consider the preamble, which set forth the structure of the collar, as limiting the claim. The court found that the collar structure could not be ignored. While the claim was not directly limited to the collar, the collar structure recited in the preamble did limit the structure of the driver. “The framework- the teachings of the prior art- against which patentability is measured is not all drivers broadly, but drivers suitable for use in combination with this collar, for the claims are so limited.”

These types of situations discussed in MPEP 2111.02 are parallel to the factual situation presented by the preamble of the independent claims in the present application reciting “ink for ink jet printer”, as will be shown below.

Thus, as apparent from the title and abstract, etc. of Swift et al., the reference discloses a lithographic ink vehicle. On the other hand, the present invention is directed to an ink for an ink jet printer. The most important difference between a lithographic ink and an ink for an ink jet printer is the viscosity of the two inks. A lithographic ink is first applied by a roller, that has a uniform thickness layer of ink on its surface, on a printing plate surface or on a printing cylinder surface. The surface of the printing plate is finely roughened but is practically flat, and the ink adheres only on a pattern surface where the surface has an affinity to the ink. Then the ink is transferred onto a medium to be printed, usually a sheet of paper, by pressing the plate onto the medium. The lithographic ink should have a sufficiently high viscosity, Applicant imagines, because if the viscosity is too low, the printing pattern might be deformed by pressure at the time of transfer.

Swift et al. disclose viscosities of the vehicles (that are 60 % resin solutions) for the ink such as 200,000 cps (Example 1), 127,000-170,000 cps (Examples 2-5), 146,000-184,000 cps (Examples 6-8), 51,000-260,000 cps (Examples 9-18), 131,000-2000,000 cps (Examples 19-26), and 33,250-131,000 cps (Examples 27-35). The vehicle is mixed with colorants and other additives along with a small amount of solvent. Thus, the lithographic ink has a high viscosity.

On the contrary, an ink for an jet ink printer should have a relatively much lower viscosity because as is easily understood, the ink should be emitted through narrow spaces formed in a printer head. [Also see page 15, line 3 to page 16, line 9 of the substitute specification concerning viscosity.] It is well known to the person skilled in the art that the viscosity of an ink for an ink jet printer is much lower than the viscosities for the lithographic ink of Swift et al., as apparent from, for example, the enclosed partial copies of references showing viscosities of ink jet printer ink of 2-20 cp (U.S. 6,290,764), 30 mPa·s (equivalent to 30 cP, U.S. 5,328,504, column 6, lines 61-68), 15 cP or less (U.S. 5,492,952, column 7, line 61), below 20 cP (EP 0 568 841 A1, page 5, lines 12-13).

The difference in viscosity between the ink jet ink and the lithographic ink is about 10,000 times or more. Thus, the field of use and technology are completely different between the lithographic ink of Swift et al. and the ink jet ink of the present invention.

Although there is no numerical range for the viscosity of the ink of the present invention, recited in the claims of the present application, the expression “for ink jet printer” in the preamble of

the claims, it is apparent that, based on the discussion of the comparative viscosities set forth above, the claims inherently exclude the lithographic ink of the Swift et al. reference. Taken in the context of MPEP 2111.02 as discussed above, the expression "for ink jet printer" limits the composition of the claimed ink, just as the expression "for setting a joint of a threaded collar" in the claim preamble limited the structure of the driver in *In re Stencel* as discussed above.

Furthermore, the Examiner states that in Swift et al., the ink also includes metal soap such as manganese naphthenate and cobalt naphthenate. However, the function of the metal soap is quite different in Swift et al., where it is used as a "dryer" that is a catalyst for air (oxygen) curing of the alkyd varnish (see the attached copy of a page of the "McGraw-Hill Dictionary of Scientific and Technical Terms"). In the high viscosity lithographic ink, the once mechanically dispersed colorant does not deposit as sediment under a normal storage condition, and a dispersant using an electrostatic phenomena is not necessary.

With regard to Takao et al., as the Examiner states, they disclose that the hydrocarbon solvent possesses resistivity of less than  $10^9 \Omega\text{cm}$ , but disclose nothing about the ink composition of the present invention.

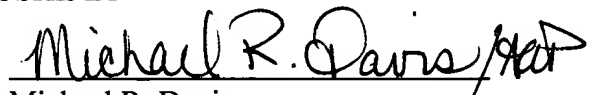
For these reasons, Applicants take the position that the presently claimed invention is clearly patentable over the cited references.

Therefore, in view of the foregoing remarks, it is submitted that the ground of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

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August 26, 2004



US006290764B1

(12) **United States Patent**  
**Shibata**

(10) **Patent No.:** **US 6,290,764 B1**  
(45) **Date of Patent:** **Sep. 18, 2001**

(54) **INK FOR ELECTROSTATIC INK JET PRINTING**

5,952,048 \* 9/1999 Tsubuko et al. .... 427/288

**FOREIGN PATENT DOCUMENTS**

(75) **Inventor:** **Hiroshi Shibata, Fukuoka-ken (JP)**

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(73) **Assignee:** **Matsushita Electric Industrial Co., Ltd., Osaka (JP)**

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(\*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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*Primary Examiner*—Helene Klemanski

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(21) **Appl. No.:** **09/515,867**

(22) **Filed:** **Feb. 29, 2000**

(30) **Foreign Application Priority Data**

Mar. 4, 1999 (JP) ..... 11-056514

(51) **Int. Cl.**<sup>7</sup> ..... **C09D 11/02**

(52) **U.S. Cl.** ..... **106/31.57; 106/31.65; 106/31.88; 106/31.33**

(58) **Field of Search** ..... **106/31.33, 31.57, 106/31.65, 31.88**

(56) **References Cited**

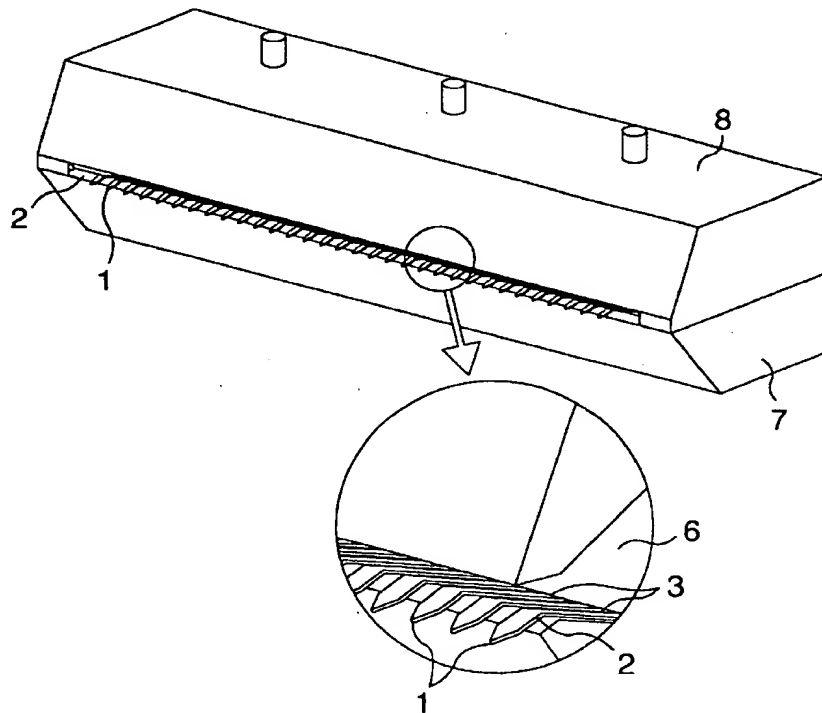
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5,453,121 \* 9/1995 Nicholls et al. .... 106/31.66

(57) **ABSTRACT**

Ink for an electrostatic ink jet printer in which, inter alia, the ink and its insulative solvent and color material particle have the following properties: the ink has a volume resistivity of  $10^9$  to  $10^{12}$   $\Omega$ cm and a viscosity of 2 to 20 cp; the insulative solvent has a volume resistivity equal to or more than  $10^{10}$   $\Omega$ cm; and the color material particle has an average diameter of between 0.1 and 2  $\mu$ m, an absolute value for the ratio ( $\xi$  electric potential/viscosity) between 10 to 100 (mV/cp), and an absolute value for the  $\xi$  electric potential of 30 mV to 200 mV. By means of these conditions, the ink provides higher density images, especially at faster printing speeds.

**5 Claims, 5 Drawing Sheets**





US005328504A

**United States Patent** [19][11] **Patent Number:** **5,328,504****Ohnishi**[45] **Date of Patent:** **Jul. 12, 1994**[54] **IMAGE RECORDING INK**[75] **Inventor:** **Hiroyuki Ohnishi, Nagano, Japan**[73] **Assignee:** **Seiko Epson Corporation, Tokyo, Japan**[21] **Appl. No.:** **831,653**[22] **Filed:** **Feb. 7, 1992****Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 564,483, Aug. 9, 1990, abandoned.

[30] **Foreign Application Priority Data**

Aug. 9, 1989 [JP] Japan ..... 1-206551  
Aug. 11, 1989 [JP] Japan ..... 1-208863  
Jul. 23, 1990 [JP] Japan ..... 2-194240

[51] **Int. Cl.<sup>5</sup>** ..... **C09D 11/00**[52] **U.S. Cl.** ..... **106/20 D; 106/20 C; 106/22 C; 106/23 C**[58] **Field of Search** ..... **106/20, 22, 23, 30, 106/31, 32, 20 C, 20 D, 22 C, 23 C**[56] **References Cited****U.S. PATENT DOCUMENTS**

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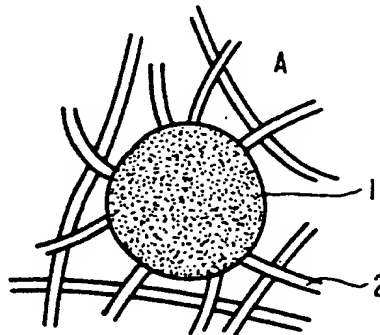
*Primary Examiner*—Karl Group

*Assistant Examiner*—Scott L. Hertzog

*Attorney, Agent, or Firm*—Sughrue, Mion, Zinn, Macpeak & Seas

[57] **ABSTRACT**

An image recording ink composition for use in a printer for recording letters and images with a liquid ink is disclosed, comprising water and a coloring material and containing at least one water-insoluble component. The ink composition is excellent in rapid drying properties, fixing properties, freedom from obstruction in a printing machine, and preservability, and provides an image excellent in terms of blurring, density, gloss, water resistance, and light resistance.

**12 Claims, 1 Drawing Sheet**

Type: Semi-solution polymer having properties intermediate between those of a water-soluble resin and a water-dispersible resin (i.e., an emulsion).

If desired, a pH adjustor and an auxiliary solvent can be added to the dispersion to impart water-solubility.

Examples of colloidal dispersions for use in the present invention include shellac, a styrenated shellac, a styrene-maleic acid resin, a rosin-maleic acid resin, casein, a casein derivative and an acrylic copolymer.

Examples of the auxiliary solvent include aqueous ammonia, an organic amine, an inorganic hydroxide and an alcohol.

Particle diameter: 0.001 to 0.1  $\mu\text{m}$

Molecular weight: 10,000 to 100,000

(2) Organic ultrafine particles (e.g., Microgel manufactured by Nippon Paint Co., Ltd.)

Type: Thermoplastic polymer

Composition: Copolymer or homopolymer of styrene, methylmethacrylic acid, n-butyl-acrylate, acrylic acid, etc., a vinyl acetate polymer, a vinyl chloride polymer, a synthetic rubber (e.g., SBR, NBR), a polyurethane, a polyester, an alkyd resin, an epoxyester polymer, a rosin ester polymer, a polyvinylidene chloride, a silicone resin, a polybutene, an EVA polymer, a polyethylene, a polypropylene, etc.

Particle diameter: 20 nm to 500 nm

Molecular weight: 1,000,000 or larger

(3) Microemulsion (e.g., PB-300 series manufactured by Kao Corporation)

Type: Acrylic resin

Typical Monomer Composition: Acrylic acid, methylacrylic acid, methylmethacrylic acid, etc.

Particle diameter: 0.1  $\mu\text{m}$  or less

Molecular weight: About 10,000 to 1,000,000.

(4) Ultramicroemulsion

The basic constitution of an ultramicroemulsion is the same as that of a microemulsion as described above.

Particle diameter: 0.005 to 0.03  $\mu\text{m}$ .

Molecular weight: About 10,000 to 1,000,000.

The above described resin emulsion can be used as a water-insoluble colored emulsion by dyeing with a dye. Furthermore, the resin emulsion can be added as the water-insoluble component other than a coloring material.

The water-insoluble resin emulsion is preferably used in an amount of from 1 to 20% by weight calculated as a solid content, based on the ink composition.

The water-insoluble component is preferably used in an amount of from 2 to 30% by weight based on the ink composition.

The water-insoluble component preferably has a particle diameter of from 0.001  $\mu\text{m}$  to 10  $\mu\text{m}$ . If the particle diameter exceeds 10  $\mu\text{m}$ , the water-insoluble component tends to precipitate.

The solvent having a high-boiling point and low volatility for use in the present invention has a boiling point of at least 180° C. and a vapor pressure of not more than about 0.2 mmHg at room temperature. Examples thereof include glycerin, ethylene glycol, propylene glycol, hexylene glycol, diethylene glycol, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, 2-pyrrolidone, N-methyl-2-pyrrolidone, 1,3-dimethylimidazolidinone, thiodiglycol, polyethylene glycol, etc. The solvent having a high-boiling point and low volatility is contained in the ink composition in an amount of from 1 to 20 wt %, and preferably from 2 to 15 wt %.

The ink composition of the present invention necessarily contains water. Other solvents which may be used for preparing the ink composition of the present invention include water and water-soluble organic solvents, such as alkyl alcohols having from 1 to 4 carbon atoms, ketones or keto alcohols, ethers, polyalkylene glycols, alkylene glycols having from 2 to 6 carbon atoms in the alkylene moiety thereof, glycerin, lower alkyl ethers of polyhydric alcohols, N-methyl-2-pyrrolidone, and triethanolamine. The water for use in the present invention is ion-exchange treated water. Water-soluble organic solvents used to prepare the ink composition of the present invention may be removed by evaporation.

Water or the ion-exchanged water is preferably used in an amount of from 50 to 95% by weight, more preferably from 60 to 90% by weight, based on the ink composition.

The calcium ion and magnesium ion concentrations in the ion-exchanged water are preferably at most 5 ppm.

The ink composition of the present invention may contain a water-soluble resin in combination with the water-insoluble component in order to improve fixing properties, to adjust the viscosity and to improve drying properties. Examples of useful water-soluble resins include glue, gelatin, casein, albumin, gum arabic, alginic acid, methyl cellulose, carboxymethyl cellulose, polyethylene oxide, hydroxyethyl cellulose, polyvinyl alcohol, polyacrylic acid, polyvinyl ether, and polyvinylpyrrolidone.

The water-soluble resin is preferably used in an amount of from 0.01 to 10% by weight, more preferably from 0.1 to 5% by weight, based on the ink composition.

The ink composition of the present invention other than those wherein a water-soluble dye is dissolved in water may further comprise a penetrant in order to permeate a solvent of the ink composition alone into the printed material. Use of the penetrant retains the coloring material on the surface of the printed material to thereby impart faster drying properties. Examples of the penetrant for use in the present invention include alkali metal hydroxides (e.g., lithium hydroxide, sodium hydroxide and potassium hydroxide), various surface active agents, methyl alcohol, ethyl alcohol, n-propyl alcohol, iso-propyl alcohol, n-butyl alcohol, diethylene glycol monobutyl ether, triethylene glycol monomethyl ether, N-methyl-2-pyrrolidone, and 1,3-dimethyl-2-imidazolidinone.

The penetrant is preferably used in an amount of from 0.005 to 10% by weight, more preferably from 0.01 to 5% by weight, based on the ink composition.

If desired, the ink composition of the present invention may further contain various known additives for printing inks such as dispersing agents, viscosity modifiers, surface-tension modifiers, specific-resistance modifiers, pH adjustors, antifungal agents, chelating agents, etc.

The ink composition of the present invention preferably has a viscosity of not more than 30 mPa.s in the vicinity of a jet nozzle at a working temperature of from 0° to 50° C., taking the stability of the ink supply to a recording head and the stability of jetting ink droplets in high-speed recording into consideration. To achieve a higher speed of recording, a viscosity of from 1.5 to 20 mPa.s is particularly preferred. The term "high-speed



US005492952A

**United States Patent** [19]

Tonogaki et al.

[11] **Patent Number:** 5,492,952[45] **Date of Patent:** Feb. 20, 1996[54] **INK, INK-JET RECORDING PROCESS AND APPARATUS MAKING USE OF THE SAME**[75] **Inventors:** Masahiko Tonogaki; Yuko Suga, both of Tokyo; Akio Kashiwazaki; Aya Takaide, both of Yokohama, all of Japan[73] **Assignee:** Canon Kabushiki Kaisha, Tokyo, Japan[21] **Appl. No.:** 212,792[22] **Filed:** Mar. 15, 1994[30] **Foreign Application Priority Data**Mar. 22, 1993 [JP] Japan ..... 5-062111  
Apr. 9, 1993 [JP] Japan ..... 5-083511[51] **Int. Cl.<sup>6</sup>** ..... C09D 11/00[52] **U.S. Cl.** ..... 524/192; 106/20 D; 347/100[58] **Field of Search** ..... 524/192; 106/20, 106/32, 22, 30; 347/100[56] **References Cited****U.S. PATENT DOCUMENTS**

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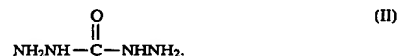
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**Primary Examiner**—Jeffrey T. Smith**Attorney, Agent, or Firm**—Fitzpatrick, Cella, Harper & Scinto[57] **ABSTRACT**

Provided is an ink comprising a compound having at least one carbonyl group and a hydrazide compound selected from the group consisting of a styrene-maleic acid resin having at least two hydrazide groups, a polyacrylic acid having at least two hydrazide groups and a compound represented by the formula



wherein R represents  $(\text{CH}_2)_n$  or  $\text{C}_6\text{H}_4$ , where n is an integer of 0 to 10, or the formula

**14 Claims, 3 Drawing Sheets**

a small size, the tumbling medium is used in a large packing fraction, the dispersion is carried out for a long time, treated products are slowly discharged, or, after being pulverized, they are classified using a filter or a centrifugal separator. Any of these methods may also be used in combination.

As a second ink according to the first embodiment of the ink of the present invention, the ink comprises the hydrazide compound, an aqueous medium, and a dye having at least one carbonyl group as the compound having at least one carbonyl group.

The dye having at least one carbonyl group may include dyes having a carbonyl group, a carboxyl group, an ester bond, an amide bond, a ketone group, a urethane bond or the like, as exemplified by various dyes such as direct dyes, acid dyes, food dyes, basic dyes, reactive dyes, disperse dyes, vat dyes, soluble vat dyes, reactive disperse dyes and oil dyes. Of these dyes, water-soluble dyes are particularly preferred in view of performances of the ink.

The content of the dye in the ink depends on the types of liquid medium components, the properties required for the ink, and so forth. In usual instances, the dye may be contained in an amount of approximately from 0.2 to 20% by weight, preferably from 0.5 to 10% by weight, and more preferably from 1 to 5% by weight, based on the total weight of the ink.

As the aqueous medium, the same one as that in the first ink previously described may be used. In the second ink, the most preferable aqueous medium is composed of water and at least one organic solvent, where the organic solvent is at least one water-soluble organic solvent with a high boiling point as exemplified by polyhydric alcohols such as diethylene glycol, triethylene glycol, glycerol, 1,2,6-hexanetriol and thiodiglycol, and 2-pyrrolidone.

The water-soluble organic solvent and the water may be contained in the ink each in the same amount as in the case of the first ink.

As the hydrazide compound, the same compounds as those in the first ink can be used.

In addition to the components described above, various kind of dispersant, surface active agent, viscosity modifier, surface tension modifier, fluorescent brightener and so forth may be optionally added to the second ink of the present invention.

As the viscosity modifier, polyvinyl alcohol, celluloses, water-soluble resins or the like are suitable. As the surface active agent, all sorts of surface active agents of cationic, anionic and nonionic types can be used. As the surface tension modifier, diethanolamine and triethanolamine are suitable. Besides, pH adjustors using buffers, antifungal agents, and so forth may also be used.

In the case of inks applied in ink-jet recording in which the ink is electrostatically charged, a resistivity regulator including inorganic bases such as lithium chloride, ammonium chloride or sodium chloride is added.

In order to solve the problems of feathering and drying performance of recorded matter and penetrability and at the same time improve compatibility with ink-jet recording heads, the second ink of the present invention may preferably be adjusted to have, as physical properties of the ink itself, a surface tension of from 30 to 68 dyne/cm and a viscosity of 15 cP or less, and more preferably 5 cP or less, at 25° C.

**Second Preferred Embodiment: (Embodiment in which a compound having oxazolyl groups is used)**

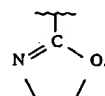
The ink of the present invention may also comprise a component having an oxazolyl group and a compound

having at least one carbonyl group.

Use of the ink of the present embodiment makes it possible to obtain stable recorded images having a superior fixing speed or rub-off fastness and which are free from a decrease in print density. This is presumably because the compound having oxazolyl groups has the properties of uniformly dissolving in an aqueous solution and, once water has disappeared, reacting with the compound having at least one carbonyl group. More specifically, it is presumed that component (a) (the compound having oxazolyl groups) in the ink of the present embodiment is uniformly dissolved in the ink, and, once this ink has been ejected from an ink-jet recording head onto recording paper and has dried, the oxazolyl group possessed by component (a) and the carbonyl group possessed by component (b) (the compound having at least one carbonyl group) combine to form a cross-linked structure, which brings about a formation of a film of non-volatile components, whereby an improvement in rub-off fastness of prints can be achieved. It is also presumed that the cross-linking reaction uniformly takes place without regard to the types of paper, and hence any dependence of print quality on recording paper can be eliminated.

The component (a) used in the ink of the present embodiment comprises (a-1): a water-soluble resin having an oxazolyl group or (a-2): a fine particle having oxazolyl groups adsorbed on its outer surface. The component (a) may include oxazoline type reactive polymers. The oxazoline type reactive polymers are commercially available, including, for example, K-1000 series and K-2000 series acryl-styrene resins, RPS series styrene resins and RAS series acrylonitrile-styrene resins, produced by Nippon Shokubai Kagaku Kogyo Co., Ltd.

The water-soluble resin (a-1) refers to, for example, an oxazoline type reactive polymer having one or more oxazolyl groups represented by the formula



(1)

The fine particle (a-2) used in the present embodiment may include organic particles and inorganic particles without any particular limitations. Those insoluble in water and capable of being stably dispersed therein are preferred. There are also no particular limitations on particle diameter. Spherical particles may preferably be used. Stated specifically, the organic fine particles may include particles of polystyrene, styrene-acrylate copolymers, polymethyl methacrylate, melamine resins, epoxy resins, silicone resins, benzoguanamine resins, polyamide resins, fluorine resins, and polymers obtained by emulsion polymerization of  $\alpha,\beta$ -unsaturated ethylenic monomers. The inorganic fine particles may include a large number of materials such as titanium dioxide particles, silica particles and alumina particles. As commercially available products, the organic fine particles may include MUTICLE series products, available from Mitsui Toatsu Chemicals, Inc. ME series products, available from Soken Chemical & Engineering Co., Ltd.; JULIMER MB series products, available from Nihon Junyaku Co., Ltd.; TOSPEARL series products, available from Toshiba Silicone Co., Ltd.; EPOSTAR series products, available from Nippon Shokubai Kagaku Kogyo Co., Ltd.; MICROGEL series products, available from Nippon Paint Co., Ltd.; and FLUON series products, available from Asahi Glass Co., Ltd. The inorganic fine particles may include titania series products, available from Indemitsu Kosan Co.,



(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) Publication number:

**0 568 841 A1**

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: **93106052.9**

(51) Int. Cl.<sup>5</sup>: **G03F 1/00, G03F 7/004,  
G03F 7/095**

(22) Date of filing: **14.04.93**

(30) Priority: **07.05.92 US 880089**

(43) Date of publication of application:  
**10.11.93 Bulletin 93/45**

(84) Designated Contracting States:  
**DE FR GB**

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(54) **Process of photoimaging using ink jet printing.**

(57) A process of photoimaging a photosensitive element comprises the steps of applying a photosensitive layer to a support; generating an actinic radiation-opaque, pigmented ink jet ink image layer on the photosensitive layer by ink jet printing, wherein the ink does not react with or substantially penetrate into the photosensitive layer; exposing the photosensitive layer to actinic radiation through the image layer; and developing to form an image. Optionally, a cover sheet may be applied to the photosensitive layer and the image layer generated on the cover sheet.

**EP 0 568 841 A1**

dispersion stability, which is critical throughout the life of the ink. Brownian motion of minute particles will help prevent the particles from settling. Small particles are also desired for maximum optical density or maximum efficiency in modulating the radiation. The range of useful particle size is approximately 0.005 to 15 microns and most preferably, from 0.01 to 0.3 micron. Carbon black having an extremely broad absorption spectrum is the preferred pigment for the present invention.

The selected pigment may be used in either dry or wet (i.e., presscake) form. In presscake form, the pigment is not aggregated to the extent that it is in dry form and, thus, do not require as much deaggregation in the process of preparing the inks from dry pigments. Representative commercial dry and presscake pigments that may be used in practicing the invention are disclosed in the aforementioned US Patent 5,085,698. The pigment dispersions can be conveniently prepared by one skilled in the art using many conventional milling techniques such as media milling.

The ink needs to have a viscosity matching that of the printhead design to ensure smooth delivery of ink droplets. Useful viscosities for the typical printheads are below 20 cP, preferably below 10 cP at 20° C. Surface tension is an important property because it prevents the ink from dripping out of the nozzles and helps maintain droplet integrity to avoid splattering. Useful surface tension ranges from 20-80 dyne/cm, preferably 25-70 dynes/cm at 20° C.

#### B) Solvent based Inks

The solvent based inks comprise a pigment dispersion and a solvent. Printing units equipped with printheads designed to handle such solvent systems are commercially available from, e.g. Videojet Systems, Division of A. B. Dick Company, Elk Grove Village, IL. The pattern generated with such inks is used as a photomask in the subsequent exposure step.

Useful solvents have reasonably high volatility so that the ink dries rapidly once ejected from the nozzles, low toxicity, and preferably do not have an offending odor. A solvent with high boiling point can be used in combination with the highly volatile solvent to prevent the nozzles from clogging during periods of non-use of the ink jet printer. Examples of useful solvents include:

- (1) alcohols, such as methanol, ethanol, 1-propanol, 2-propanol, butanol, etc.,
- (2) ketones such as methylethyl ketone, methyl isobutyl ketone, cyclohexanone, etc.,
- (3) ethers such as ethyleneglycol monomethyl ether, ethyleneglycol monoethyl ether, ethyleneglycol diethyl ether, etc.,
- (4) esters such as ethyl acetate, butyl acetate, etc.,
- (5) aromatics such as benzene, toluene, xylene, etc., and
- (6) chlorinated solvents such as methylene chloride, chloroform, carbon tetrachloride, ethylene dichloride, trichloroethylene, etc.

These organic solvents can be used alone or in combination with other organic solvents to optimize the ink properties such as viscosity, surface tension, etc., and performance features such as drying speed of ink after printing, print quality including dot shape and edge acuity, nozzle clogging, etc.

Solvent based pigment dispersions have been extensively used in many industrial applications including paints, plastic sheets, colored films, etc. The materials and procedures for preparing such dispersions are well known and have been described in the literature. Various polymers including random, block and branched types of polymers have been used to disperse the pigments. The important properties of the polymeric dispersant required for ink jet inks include good solubility in the chosen carrier medium, strong interaction with the pigment surface, and sufficient molecular weight to contribute to the dispersion stability. The molecular weight and the concentration of the polymer are useful parameters for controlling the viscosity of the final ink.

#### EXPOSURE

After the image layer has been generated on the photosensitive element and dried, the element is exposed to actinic radiation through the image layer in the same manner as conventional photoimaging using non-integral photomasks. Any radiation source emitting radiation having the proper wavelength and adequate intensity can be used. Some suitable sources include mercury and mercury-xenon, carbon arc lamps, and other conventional ultraviolet, visible, or infrared sources.

The duration of the exposure, distance between the radiation source and the photosensitive element and other parameters involved in the exposure step will depend on the particular photosensitive material being exposed, the radiation source being used, the desired application or end use of the photosensitive element, etc. Such matters are well within the knowledge of the ordinary skilled artisan.

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the study of diffusion of a solid material *A* into a stream of vapor initially composed of substance *B*, equal to

$$\frac{Z_A(M_A - M_B) + M_B}{(Z_A - Y_{AW})(M_B - M_A)} \cdot \ln \frac{M_V}{M_W}$$

where  $M_A$  and  $M_B$  are the molecular weights of components *A* and *B*,  $M_V$  and  $M_W$  are the molecular weights of the mixture in the vapor and at the wall, and  $Y_{AW}$  and  $Z_A$  are the mole fractions of *A* at the wall and in the diffusing stream, respectively. Symbolized  $N_D$ . { 'drü, nəm-bär }

**drewite** [GEOL] Calcareous ooze composed of impalpable calcareous material. { 'drü,ti }

**drex** [TEXT] A unit of yarn density (mass per unit length), equal to 1 gram per 10 kilometers of yarn fiber. { 'drexks }

**dribbling** [MIN ENG] Fall of debris from the roof of an excavation, usually preceding a heavy fall or cave-in. { 'drib-liŋ }

**drier** [ENG] A device to remove water. [MATER] 1. A substance that absorbs water. 2. A substance that is used to hasten solidification. 3. Material, such as salts of lead, manganese, and cobalt, which facilitates the oxidation of oils; used in paints and varnishes to speed drying. { 'dri-ər }

**drift** [ENG] 1. A gradual deviation from a set adjustment, such as frequency or balance current, or from a direction. 2. The deviation, or the angle of deviation, of a borehole from the vertical or from its intended course. 3. To measure the size of a pipe opening by passing a mandrel through it. [GEOL]

1. Rock material picked up and transported by a glacier and deposited elsewhere. 2. Detrital material moved and deposited on a beach by waves and currents. [MECH ENG] The water lost in a cooling tower as mist or droplets entrained by the circulating air, not including the evaporative loss. [MIN ENG] A horizontal mine opening which follows a vein or lies within the trend of an ore body. Also known as gallery. [NAV] 1. The movement of a craft caused by the action of wind or current. 2. To move gradually from a set position without control. [OCEANOGR] See drift current. [SOLID STATE] The movement of current carriers in a semiconductor under the influence of an applied voltage. { drift }

**Drift I** [ASTRON] A group of stars that tend to move in a stream, traveling in the direction of the constellation Orion; it comprises 60% of the stars whose proper motions are known. { 'drift, wən }

**Drift II** [ASTRON] A group of stars that tend to move in a stream, traveling in the direction of the constellation Scutum; it comprises 40% of the brighter stars. { 'drift, tü }

**drift angle** [NAV] 1. The horizontal angle between the axis of a ship and the tangent to its path. Also known as drift correction angle. 2. The angle between the longitudinal axis of an aircraft and its path relative to the ground. { 'drift, æŋ-gəl }

**drift axis** [NAV] Of a gyroscope, the axis about which drift occurs; for example, in a directional gyro with the spin axis mounted horizontally, the drift axis is the vertical axis. { 'drift, æk-səs }

**drift bolt** [ENG] 1. A bolt used to force out other bolts or pins. 2. A metal rod used to secure timbers. { 'drift, bōlt }

**drift bottle** [OCEANOGR] A bottle which is released into the sea for studying currents; contains a card, identifying the date and place of release, to be returned by the finder with date and place of recovery. Also known as float. { 'drift, bād-əl }

**drift card** [OCEANOGR] A card, such as is used in a drift bottle, encased in a buoyant, waterproof envelope and released in the same manner as a drift bottle. { 'drift, kârd }

**drift-corrected amplifier** [ELECTR] A type of amplifier that includes circuits designed to reduce gradual changes in output, used in analog computers. { 'drift kə'rek-təd 'æm-plə,fī-ər }

**drift correction angle** See drift angle. { 'drift kə'rek-shən æŋ-gəl }

**drift current** [OCEANOGR] 1. A wide, slow-moving ocean current principally caused by winds. Also known as drift; wind drift; wind-driven current. 2. Current determined from the differences between dead reckoning and a navigational fix. [PL PHYS] A current of free charged particles in perpendicular electric and magnetic fields that results from an average motion of the particles in a direction perpendicular to both fields. { 'drift, kə-rənt }

**drift dam** [GEOL] A dam formed by glacial drift in a stream valley. { 'drift, dam }

**drift diameter** [PETRO ENG] 1. The effective width of a hole in a drilling operation. 2. The minimum diameter of the casing being installed in a wellbore. { 'drift dī'am-əd-ər }

**drifter** [MECH ENG] A rock drill, similar to but usually larger than a jack hammer, mounted for drilling holes up to 4 1/2 inches (11.4 centimeters) in diameter. [MIN ENG] 1. A person who excavates mine drifts. 2. An air-driven rock drill used for excavating mine drifts and crosscuts. { 'drif-tər }

**drift error** [COMPUT SCI] An error arising in the use of an analog computer due to gradual changes in the output of circuits (such as amplifiers) in the computer. { 'drift, er-ər }

**drift glacier** See snowdrift glacier. { 'drift, glā-shər }

**drift ice** [OCEANOGR] Sea ice that has drifted from its place of formation. { 'drift, is }

**drift ice foot** See ramp. { 'drift, is, fūt }

**drift indicator** [ENG] Device used to record directional logs; records only the amount of drift (deviation from the vertical), and not the direction. [NAV] See drift meter. { 'drift, in-də,kād-ər }

**drifting** [MIN ENG] Tunneling along the strike of a lode. { 'drif-tiŋ }

**drifting mine** [ORD] An underwater mine adjusted to float unanchored on or just below the surface of the water. { 'drif-tiŋ, mīn }

**drifting snow** [METEOROL] Wind-driven snow raised from the surface of the earth to a height of less than 6 feet (1.8 meters). { 'drif-tiŋ 'snō }

**drift lead** [NAV] A lead placed on the bottom to indicate movement of a vessel; at anchor the lead line is usually secured to the rail with a little slack and if the ship drags anchor, the line tends forward; also used to indicate when a vessel coming to anchor is dead in the water or when it is moving astern, or to indicate current if a ship is dead in the water. { 'drift, led }

**drift meter** [NAV] An instrument for measuring drift angle. Also known as drift indicator; drift sight. { 'drift, mēd-ər }

**drift mining** [MIN ENG] Working of shallow veins or beds through drifts or shafts from the surface. { 'drift, mīn-iŋ }

**drift mobility** [SOLID STATE] The average drift velocity of carriers per unit electric field in a homogeneous semiconductor. Also known as mobility. { 'drift mō'bil-əd-ē }

**drift observation** [NAV] Also known as drift sight. 1. The process of observing drift or leeway. 2. The value obtained by such an observation. { 'drift, əb-zər,vā-shən }

**drift pin** [DES ENG] A round, tapered metal rod that is driven into matching rivet holes of two metal parts for stretching the parts and bringing them into alignment. { 'drift, pin }

**drift plug** [ENG] A plug that can be driven into a pipe to straighten it or to flare its opening. { 'drift, plæg }

**drift sight** See drift meter. { 'drift, sīt }

**drift space** [ELECTR] A space in an electron tube which is substantially free of externally applied alternating fields and in which repositioning of electrons takes place. { 'drift, spās }

**drift speed** [ELEC] Average speed at which electrons or ions progress through a medium. { 'drift, spēd }

**drift station** [OCEANOGR] 1. A scientific station established on the ice of the Arctic Ocean, generally based on an ice flow. 2. A set of observations made over a period of time from a drifting vessel. { 'drift, stē-shən }

**drift terrace** See alluvial terrace. { 'drift, tər-əs }

**drift transistor** [ELECTR] 1. A transistor having two plane parallel junctions, with a resistivity gradient in the base region between the junctions to improve the high-frequency response. 2. See diffused-alloy transistor. { 'drift tran,zis-tər }

**drift tube** [NUCLEO] A tubular electrode placed in the vacuum chamber of a circular accelerator, to which radio-frequency voltage is applied to accelerate the particles. { 'drift, tūb }

**drift ultrasonic flowmeter** See deflection ultrasonic flowmeter. { 'drift əl-trə'sān-ik 'flō,mēd-ər }

**drift velocity** [SOLID STATE] The average velocity of a carrier that is moving under the influence of an electric field in a semiconductor, conductor, or electron tube. { 'drift və'lās-əd-ē }

**drift wave** [PL PHYS] An oscillation in a magnetically confined plasma which arises in the presence of density gradients, for example, at the plasma's surface, and which resembles the waves that propagate at the interface of two fluids of different density in a gravity field. { 'drift, wāv }

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